

## Jay Mazalewski

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**From:** Scott Rogers <scott.rogers@aquaeng.com>  
**Sent:** Tuesday, September 17, 2019 9:23 PM  
**To:** Jay Mazalewski; 'Jared Gunderson'; 'Steve Zollinger'; 'Mayor Johnson'  
**Subject:** RE: Driggs WWTP - Breakpoint Chlorination

Jay,

I have looked at using chlorine to remove ammonia and have come up with the following:

- The amount of chlorine needed will vary between 6 parts and 10 parts per part ammonia removed. I will use 8 for our analysis. I assumed the design flow 0.9 mgd at 20 mg/l ammonia for the capex and the opex, realizing that average annual flows today are much less than that, and that the effluent ammonia also runs much less than that. It is a straight line relationship regarding the amount of chlorine needed and the ammonia removed, at a given temperature. Temperature affects both biological and chemical ammonia removal.
- It is recommended that the pH be raised to 8.5 in the effluent so that the chlorine will work more effectively. The most effective way to do that is with sodium hydroxide. It will cost about \$0.30 per dry pound delivered. I will assume about 100 mg/l needed which will require about \$100,000 per year at the design flow.
- You will need sulfur dioxide to remove the excess chlorine from the flow. We will assume that the usage will be about 10% of the chlorine usage.
- To be cost effective, both chemicals will need to be stored in one ton cylinders. The cost of both chemicals is about \$2500 per ton delivered. At the design parameters, you would need 220 tons per year or \$550,000, with SO2 being 10% of that.
- A risk management plan will have to be developed showing what would happen if a one in hole in a cylinder were to occur and basically how many people would die in the path of the gas dispersion. Most people install a gas scrubber to mitigate this. There would have to be one for chlorine and one for SO2. I have done several of these types of storage, metering, and scrubbing facilities.
- The cylinders would be kept in separate storage rooms, also separate from the metering equipment. All areas would be classified as corrosive and as such would require special electrical and materials of construction.
- To use the chlorination as disinfection, and be able to turn off the UV, a chlorine contact chamber would have to be built having with 60 minutes detention time at average flow with a serpentine layout. If you keep the UV on, this will not be needed, but you still need a reaction chamber for the pH adjustment and for which we could use the floc chamber ahead of the clarifier, a reactor for the chlorine, and a reactor for the dechlor.
- The labor for all this will require about 0.25 people in my opinion, or about 2 hours per day. If an operator with benefits costs about \$90K per year, then about \$20K per year of that will be spent on this effort.

Here is a summary of the **CAPEX**:

Chlorination Equipment Feed	\$150,000
Chlorination Storage and load / unload	\$100,000

SO2 Equipment Feed	\$150,000
SO2 Storage and load/ unload	\$100,000
Building – 60 X 40	\$700,000
Caustic Tank and Feed system	\$40,000
Chlorine Contact Chamber – 40 X 40 X 8.	\$200,000
Yard Piping	\$50,000
Instrumentation Upgrade	\$80,000
Mechanical Install	\$100,000
Site Prep	\$75,000
Misc. Mechanical	\$125,000
Electrical	\$275,000
Sub total	\$2,145,000
Contingency – 25%	\$535,000
Subtotal	\$2,690,000
Engineering and Administration – 15%	\$350,000
<b>Total</b>	<b>\$3,040,000</b>

I did not put the scrubbers for a chlorine or SO2 leak in at this time. I am not sure what they cost now as I have not seen a chlor / dechlor gas system go into a plant in about 20 years. My guess is that they would cost about \$200K each.

#### OPEX

Chlorine	\$550,000
SO2	\$55,000
Caustic	\$100,000
Labor	\$20,000
Repair and Replacement	\$30,000
Power	\$10,000
<b>total</b>	<b>\$765,000</b>

#### Final comments:

There is a lot of used chlorination / sulphonation equipment along the Wasatch Front because most have gone to either UV or to liquid bleach and sodium bisulfate for safety reasons, even though it costs less to use gas. That could probably save \$300K or so in equipment costs.

The Opex will be less today because of lower flows and effluent ammonia levels most of the time.

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